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Sharp-edged fine-dust, possibly radioactive, made the Chicxulub-impact so lethal

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The extinction event at the Cretaceous-Tertiary boundary wiped out numerous marine and terrestrial groups of species. The penetration depth of the Chicxulub impactor was at least approximately 30 km. The reported pressures at impact reached approximately 10 GPa–30 GPa, or, according to one author, 32,720 GPa. These discrepancies are the reason for recalculating the pressure. Based on a solid round impactor, the upper limit of the pressure was ca. 440,000,000 GPa. Large quantities of particulate matter, e.g. fine-dust were produced. According to the World Health Organization particulate matter (PM2.5) can cause cardiovascular problems and high death rates. This applies to dinosaurs and other biota too. Thus, particulate matter is considered a previously overlooked cause of the high lethality of the Chicxulub impact. Inertial nuclear fusion (nuclear fusion through pressure) appears possible too. The resulting particulate matter may thus also have been radioactive. The mass extinction at the Permian-Triassic boundary, also involving antipodal volcanism, and that of the Ordovician also had an impact as a cause. The climate change at approximately 2.6 million years ago also coincided with another impact. Thus the extinction of the pliocene Megafauna might possibly be related to this impact.

KEYWORDS

Chicxulub impact, fine-dust, lethal biological effects, mass extinctions, radioactivity

1 Introduction

The extinction event at the Cretaceous-Tertiary boundary wiped out numerous marine and terrestrial groups of species. It is considered certain that the Chicxulub impact played a significant role in this event (Alvarez et al., 1980; Brugger et al., 2016; Bambach, 2006): These sources provide overviews of relevant aspects. Some consequences include the shading of sunlight by dust and aerosols, and a drop in the Earth's mean surface temperature of approximately 26 °C (see also Kevin et al., 1997). Corresponding effects on terrestrial plants, terrestrial herbivores, and almost all terrestrial animals also occurred. Weinreb (2002) summarizes: "Marine ecosystems were also decimated at the K-T boundary. Perhaps as many as 90% of all marine species died out at the boundary: all of the ammonites, 93% of marine reptiles, 83% of planktonic foraminifera, and 65% of all sponges. More than half of all terrestrial reptiles died, including all of the dinosaurs. No terrestrial organism larger than 25 kg survived the K-T extinction. Interestingly, most of the higher forms of plants were only mildly affected, and mammals actually experienced an increase in diversity at the start of the Tertiary Era."

A sudden drop in temperature, for example, could have decimated biocenoses: Some regions became uninhabitable for certain biota. For a species to survive (in the theoretically extreme case), one male and one female living close to each other are sufficient. It can therefore be assumed that the dinosaur and ammonite populations would have recovered after some time.

There are other relevant processes involved in the Chicxulub impact. Both are extremely harmful to health, including for dinosaurs.

One of the processes, induced radioactivity (see below), is theoretically possible. The physical conditions are discussed here. The second of the two processes is the generation of particulate matter (PM2.5): The harmful health effects of anthropogenic particulate matter, according to the WHO (2021) and others, occurred after the Chicxulub event too, but probably on a much larger scale. Particulate matter, along with the additional health consequences mentioned below, such as those described by NASA for lunar regolith, is considered one of the key processes responsible for the extinction event.

2 Key confirmed phenomena

The impactor of the Chicxulub impact, aged 66,043,000 ± 11,000 years (Renne et al., 2013) in Yucatan, had a diameter of approximately 10 km according to Desch et al., 2021. This diameter is a lower limit.

It struck at a steep angle of approximately 45–60° to the horizontal from a northeasterly direction; its velocity was approximately 12 km/s (Collins et al., 2020) or between 12 and 20 km/s (Pincelli et al., 2020). The melt volume was approximately 3,934.4 km^3; the total energy of the impact was approximately 5.54×10^{30} erg (approximately 131.9×10^6 megatons TNT equivalent), see Echauren (2025).

An important question addressed in this article is radioactivity induced by pressure. Pressure depends on velocity; therefore, the higher velocity of 20 km/s—which is accepted in the literature—is used here: if induced radioactivity cannot occur at the higher velocity of 20 km/s, it will not occur at a lower velocity either.

Atzeni and Meyer-ter-Vehn (2004) mention 250 Gbar as value for inertial nuclear fusion. See for comparison First Light Fusion, 2024.

$$\text{With 1 Bar} = 100000\ \text{Pa} : 250\ \text{GBar} = 250 * 10^{(9+5)} = 250 * 10^{14}\ \text{Pa} = 250 * 10^{5}\ \text{GPa}.$$

The reported pressures at impact, more below, reached approximately 10 GPa–30 GPa, or, according to one author, 32,720 GPa with 32,270 GPa inertial nuclear fusion is possible.

Therefore, the amount generated during the Chicxulub impact is calculated below. This reveals whether the PM5 fine dust was particularly harmful to health due to induced radioactivity.

Numerous ejecta were ejected. These ejecta spread globally, leading to environmental changes such as cooling (Pincelli et al., 2020) and ocean acidification (Hull et al., 2020; Pincelli et al., 2020; Pope et al., 1997), etc. The penetration depth was at least approximately 30 km. The pressures at impact reached approximately 10 GPa (Gullick et al., 2013). These figures are reviewed and reassessed here. Senel et al. (2023) investigates the climatic effects of particulate matter from the Chicxulub impact. Around the same time as the Chicxulub impact, volcanism in the Deccan Traps in India intensified (Richards et al., 2015).

The following numbers are presented intentionally in a way, that allows for easy recalculation of the pressures using simple algebraic equations. This enables others to arrive easily at the same conclusions as the author. When assessing megaimpacts quite straightforward, readers can use the shown easy calculations as a start.

It is important to note, as verified by the author, that office calculators and online calculators often struggle with large numbers. Dedicated scientific calculators are better. The order of magnitude is crucial.

As a consequence of the impact, the first aspect to consider is the pressure at which inertial nuclear fusion occurs. The superposition of pressure waves, including reflected pressure waves, can generate pressure waves many times higher than those produced by the impact itself. The pressures during the Chicxulub impact should be considered in terms of their potential to induce pressure-induced nuclear fusion. In such a case, induced radioactivity (radioactive dust in the air as a consequence) would have contributed to the K-T extinction event.

Regarding human mortality-rates from particulate matter, the WHO (2021) states: “Particulate matter can enter the bloodstream and lead to cardiovascular disease, stroke, lung cancer, and chronic obstructive pulmonary disease (COPD).” This also applies to other biota such as dinosaurs. PM2.5 contains fifty percent of particles with a diameter smaller than 2.5 μm. PM2.5 sediments slowly in water. Marine biota such as ammonites can ingest PM2.5 through their food. Biota living at greater depths are therefore only exposed to PM2.5 once any radioactivity has largely dissipated. This could explain why nautiloids, despite a shape similar to ammonoids, survived the K-T event, while ammonoids did not.

A didactic analogy: If approximately 70,000 dinosaurs were to die each year in Germany (instead of the current number of humans due to particulate matter), a dinosaur population would quickly disappear in Germany.

The death rates during the K-T event were very likely much higher due to the high concentration of particulate matter.

3 Pressure-induced radioactivity from the Chicxulub impact?

There is such a thing as “inertial nuclear fusion” (fusion through pressure). Most examples for nuclear fusion involve deuterium (an isotope of hydrogen, H) or tritium (another isotope of H). In the Chicxulub impact, calcium (Ca), carbon (C), and oxygen (O) are relevant.

If pressure-induced radioactivity occurred during the Chicxulub impact, this could explain the high lethality, i.e., the extinction event. However, there is another likely aspect contributing to the high lethality.

Gullick et al., 2013, cite pressures of 10 GPa at the impact; Echauren, 2025, states “Pressure to 1 km of the impact point is ~32,720 GPa”. These are large differences.

The following paragraph is intentionally written so that readers can easily verify the figures with a calculator. Online calculators, as seen for this article, sometimes make mistakes with large numbers.

Whether the discrepancies between Gullick et al., 2013; Echauren, 2025, mentioned above are due to such numerical phenomena is unknown. For the Chicxulub impactor, a diameter of 14 km is used here. This corresponds to a radius of 7,000 m.

3.1 Static considerations

CL: Each value is based on the Chicxulub impact.

One Pa (Pascal) is 1 N/(m^2); 1 kg is approximately 10 N.

1 bar = 100,000 Pa.

1 erg = 10^{-7} J.

$5.54^{*}10^{30}$ erg = $5.54^{*}10^{37}$ J.

Volume of a sphere, V: $V = 4/3^{*}\pi^{*}r^{3}$.

R: Radius in meters.

Pi: 3.1415.

CL: Area of the impactor Fi: Fi = Pi*r^2 = $3.1415^{*}7{,}000^{2}$ (m^2) = 153,933,500 (m^2).

CL: V = $4/3^{*}3.1415^{*}7{,}000^{3}$ (m* m* m).

CL: V = 343,000,000,000 (m^3)*3.1415*(4/3).

CL: V = 1,436,712,000,000 m^3.

Mass = density*volume.

With density rho = 2.63 tons/cubic meter as the lower (!) limit of the density:

Mi: Mass of the impactor:

CL: Mi = 2.63*1,436,712,000,000 ((kg/(m*m*m))*(m* m* m) = kg.

CL: Mi = 3,778,554,313,330 kg.

Kinetic energy Ekin:

With v = 20 km/s (Pincelli et al., 2020), e.g., 20,000 m/s:

Ekin = ½*Mi*20,000*20,000 kg*m^2/s^2 = J.

Ekin = 1,889,277,156,665 kg*400*1,000,000 m^2/s^2 = J.

Ekin = 755,710,862,666 000*1,000,000 J.

Ekin = $755^{*}10^{18}$ J.

Speed according to Echauren (2025): 32.4 km/s = 32,400 m/s.

Mass according to Echauren (2025):

Ekin_2 = ½*3778.5*32.4*32.4*10^9 kg*1,000*1,000 m^2/s^2.

In reality:

Ekin_2 = ½*3778.5*32.4*32.4*$10^{(9+6)}$ kg*m^2/s^2 = J.

Ekin_2 = 1,983,259.1*10^{15} kg*m^2/s^2 = J.

This is much less than Echauren (2025), writes.

Echauren: $5.34^{*}10^{30}$ erg = $5.34^{*}10^{37}$ J.

One zettajoule = 10^{21} J.

For comparison: Wikipedia: 300 ZJ: $300^{*}10^{21}$ J.

This will be verified in Chapter 3.2 using kinetic energy.

Here, the impact pressure is relevant:

Weight of the stationary impactor:

Force = Mi/Fi = 3778.5/153.9*$10^{(9-6)}$ = $24.55^{*}10^{3}$ kg/(m* m).

3.2 Dynamic analysis

Momentum p:

p = m*v (N* s).

p = 3778.5*10^9 kg*32.4*10^3 m/s.

p = 122,423.4 kg*m/s*$10^{(9+3)}$) = N*s.

The following equations are used: The impactor is a solid body.

Force F = Change in momentum/Time.

Penetration depth: 30 km.

With a radius of 7 km (7,000 m), this equates to 23 km for the center point, measured upwards from the penetration depth. A radius of 7 km is considered the upper limit of the radius.

Deceleration from 32.4 km/s to 0 km/s over a 23 km braking distance:

Time, roughly (!) approximated:

Time t = 23,000 m/32,400 m/s = 0.709 s.

Force F = (122,423.4*10^{12})/0.709 (change in momentum/time, m*m/s = N*s/s = N).

F = 172,669.9*10^{12} N.

This force per square meter: F_qm:

F_qm = 172,669.9*10^{12}/153.9*10^6 (kg/(m* m)).

F_qm = 1,121.9*10^6 (kg/(m*m)) = 11,219*10^6 N/(m*m). Pressure (Pa) = 11,219*10^6 N/(m*m) = 11.2*10^9 Pa.

This is 11.2 GPa.

For comparison:

If deceleration occurs at 2,300 m instead of the above 23 km until disintegration (evaporation), the pressure is 112 GPa.

The distance-time relationship applies: v (m/s) = s (m)/t (s) with:

Distance s (m) = v (m/s)*t (s); t (s) = s (m)/v (m/s).

The above assumes continuous (!) deceleration until the center point of 23 km is reached as a rigid solid (impactor).

In reality, a crater did form, but the material vaporized. The discrepancy between the figures from Gullick et al. (2013) and Echauren (2025) is considerable.

It remains unclear: The reviewed literature does not discuss whether the crater was formed by the impactor or by the shock waves.

Due to the superposition of multiple reflections of pressure waves in the fractions of a second of the impact, multiple pressures are possible. These are then even higher pressures than mentioned above.

The temperatures caused by the impact briefly generated a plasma in the impact area with a temperature of approximately 10,000 K (Kring and Durda, 2002).

The numerous processes can overlap: Pressure-induced radioactivity (pressure-induced nuclear fusion) seems plausible. The following chapter discusses this question.

The figures are presented below in a way that makes them easy to recalculate.

3.3 Pressure at the Chicxulub impact

CL: Mi = 3,778,554,313,330 kg.

Area of the impactor, see above: 153,933,500 m^2.

Mass of the impactor, see above: 3,778,554,313,330 kg.

Pressure of the stationary impactor per square meter:

Pressure Pi: Pi = Mi/Fi (kg/(m*m)) = 3,778,554,313,330 kg/ 153,933,500 m^2 = 24,546 kg/m^2.

Note: 1 kg = approx. 10 N.

This results in: Pressure Pi = approx. 245,460 N/m^2 = 245,460 Pa.

This is the order of magnitude of the pressure of the stationary impactor at its greatest width (maximum area of the sphere).

In reality, the pressure was therefore briefly much higher: The impactor did not hit with its maximum width, but with a smaller one.

A deceleration from 12 km/s (12,000 m/s) over approximately 20 km (20,000 m) instead of 23 km results in a deceleration time of approximately 1.6 s.

Distance s (m) = 0.5*a (acceleration in m/s^2)*t^2 = (m).

Therefore: $a = 2^{*}s/t^{2}$ (m/s^{2}).

CL: Acceleration $a = 2^{*}23{,}000\ m/1.6^{2}\ s^{2} = 46{,}000\ (m)/2.56\ (s^{2}) = 17{,}968\ (m/s^{2})$.

It follows that: F (force) = m (mass)*a (acceleration) ($kg^{*}m/s^{2} = N$).

CL: $F = 3{,}778{,}554{,}313{,}330\ kg^{*}17{,}968\ m/s^{2} = 6.78930639^{*}10^{16}$ N.

With 1 Pa = 1 N/m^{2} and an impactor area of 153,933,500 m^{2} (see above), this is $6.78{,}930{,}639^{*}10^{16}\ N/153{,}933{,}500\ m^{2} = 441{,}054{,}506^{*}10^{16}$ Pa.

This is $441{,}054{,}506^{*}10^{7}$ GPa.

This value is much higher than the value of 32,720 GPa from above-mentioned Echauren (2025).

Atzeni and Meyer-ter-Vehn (2004) mention 250 Gbar as value for inertial nuclear fusion.

With 1 Bar = 100,000 Pa: 250 GBar = $250^{*}10^{(9+5)} = 250^{*}10^{14}$ Pa.

This is $250^{*}10^{(14-9)} = 250^{*}10^{5}$ GPa.

The conditions mentioned by Atzeni and Meyer-ter-Vehn (2004) for inertial nuclear fusion were thus exceeded during the Chicxulub impact.

The found numbers for inertial nuclear fusion differ considerably.

Thus, inertial nuclear fusion appears to be a possibility, that might have occurred during the Chicxulub impact.

Exothermic nuclear fusion, such as in hydrogen-bombs, is widely known. In addition, endothermic nuclear fusion exists: That requires MJ/Mol (Megajoule/Mol) energy for fusion to happen (Holzner, 2020). It is not restricted to Deuterium and Tritium. Almost any element can participate in endothermic nuclear fusion.

This is associated with numerous radionuclides. The Chicxulub impact then produced large quantities of radioactive dust. Non-radioactive particulate matter, as discussed above, is relevant too for adverse health-effects of biota, such as dinosaurs.

Both non-radioactive particulate matter and radioactive particulate matter may have contributed to the high lethality of the Chicxulub impact and the Cretaceous-Tertiary extinction event.

In this case, the formerly radioactive nuclides are detectable in the sediments. Testing the radionuclide hypothesis, e.g., sampling and corresponding analysis, is beyond the author's capabilities. This is a task for other authors.

Relevant: Deuterium in technical nuclear fusion requires much lower pressures for fusion than, for example, calcium, carbon, or oxygen in the carbonates into which the impactor struck.

The minimum conditions for pressure-induced nuclear fusion are relevant. The Sun has pressures of 250 billion bar (250 GBar) and temperatures of approximately 15 million °C (250 million Pa) during nuclear fusion. This is much less than at the Chicxulub impact.

The temperature at the Chicxulub impact was much lower than in the Sun, as mentioned above.

Thus, pressure-induced nuclear fusion was possible at the Chicxulub impact, but with lower intensity than at 15 million °C.

Therefore, very localized pressure-induced nuclear fusion (inertial nuclear fusion) occurred, leading to radioactive dust with a global distribution.

Investigating the Chicxulub site, the rocks from the corresponding boreholes, and the dust for potential (long-lived) radionuclides and/or the decay products of short-lived radionuclides is therefore advisable.

4 Fine dust as a cause of extinction events

From WHO (2021): "WHO estimates show that around 7 million deaths, mainly from noncommunicable diseases, are attributable to the joint effects of ambient and household air pollution (WHO, 2021, p. 10)."

An internet search using the keyword "Death through PM [particulate matter] according to WHO" yielded the following result, according to Google, accessed on 30 October 2025: "According to the WHO, ambient air pollution is estimated to have caused 4.2 million premature deaths globally in 2019, primarily from exposure to fine particulate matter (…) P2.5. This particulate matter can enter the bloodstream and lead to cardiovascular disease, stroke, lung cancer, and chronic obstructive pulmonary disease (COPD)." This refers to present-day conditions.

The Chicxulub impact produced a very high concentration of particulate matter in the atmosphere for many years.

The biological effects of the Chicxulub impact have not yet been adequately considered.

Particulate matter can penetrate almost all environments: air, land, and the upper layers of the ocean.

This also applies to the biological sub-areas mentioned by the WHO (above: cardiovascular disease, stroke, lung cancer, and chronic obstructive pulmonary disease).

The K/T extinction event was thus exacerbated by the known causes of death in humans caused by particulate matter.

The high concentrations of particulate matter during the K/T event were correspondingly more lethal.

The previously known causes of death that led to the K/T extinction event (cooling, etc.) are all correct.

Possible induced radioactivity and, above all, the biological effects of particulate matter are further factors that contributed to the K/T event.

Similar factors are suspected for the Permian-Triassic extinction event; see below.

5 Other impact events relevant to climate- and extinctions

In Antarctica, at approximately 70° S and 120° E, lies in Wilkes Land a crater with a diameter of about 400 km (Von Frese et al., 2009). This crater impacted approximately 260 million years ago. The Permian-Triassic extinction event was more lethal than the Cretaceous-Paleogene extinction event.

The Wilkes Land crater, like the Chicxulub crater, is also visible in gravity data (Von Frese et al., 2009 and related literature).

Frese et al. describe its size as "three times the size of the Chicxulub crater." Due to the size of the Wilkes Land crater, the amount of particulate matter (possibly also radioactive?), estimated based on the volume of the Wilkes Land crater, is much greater than that of the Chicxulub crater.

The Siberian volcanism of the Trapp Basalts lies approximately antipodal to the Wilkes Land crater (using the paleo-position of the continents), see Von Frese et al., 2009, Figure 6. Kamo et al. (2003)

considers the Siberian Trapp Basalts to be the cause of the mass extinctions at the Permian-Triassic boundary.

This disparity has led to suggestions that cooling alone cannot account for the Late Ordovician Mass Extinction (LOME), and that other factors such as eutrophication, anoxia, heavy metal toxicity or eruption of a LIP may be the primary cause of the event".

Furthermore: "Here, we show that the onset of the major phase of biodiversification around 470 Myr ago coincides with the disruption in the asteroid belt of the L-chondrite parent body—the largest documented asteroid breakup event during the past few billion years (…). The precise coincidence between these two events is established by bed-by-bed records of extraterrestrial chromite, osmium isotopes, and invertebrate fossils in Middle Ordovician strata in Baltoscandia and China. We argue that frequent impacts on Earth by kilometer-sized asteroids—supported by abundant Middle Ordovician fossil meteorites and impact craters—accelerated the biodiversification process."

Bond and Wignall (2014) in Keller and Kerr (2014) write, "The temporal link between mass extinctions and large igneous provinces is well known." As well as: "(…) we examine this link by focusing on the potential climatic effects of large igneous province eruptions during several extinction crises that show the best correlation with mass volcanism: the Frasnian-Famennian (Late Devonian), Capitanian (Middle Permian), end-Permian, end-Triassic, and Toarcian (Early Jurassic) extinctions."

Regarding the LOME, Saupe et al. (2020): none of these cooling events caused the magnitude of extinction characteristic of the LOME.

The Ordovician Glaciation may thus have been caused by large quantities of particulate matter, possibly radioactive or even toxic, and the subsequent cooling. The biodiversification mentioned by Saupe et al. may have been a consequence of the extinction event. Saupe et al. (2020) describe the eruption of a LIP as the cause of the extinction event in the Ordovician. This author views the LIP as a consequence of one or more impact events.

6 Prospection-method for further megaimpacts

This author, like Von Frese et al. (2009), has pointed out that impact events can generate large igneous provinces (LIPs) (antipodal volcanism). Von Frese et al. (2009) write: "Antipodal volcanism is common to large impact craters on the Moon and Mars and may also account for the antipodal relationship of essential half of the Earth's large igneous provinces."

LIPs are thus a method for finding megaimpacts. Therefore, this author proposes finding the "corresponding megaimpact" for every LIP or extinction event. If a volcanic event (LIP) exists, it also involves an often still unknown megaimpact. Therefore, a mega-impact must first be explicitly ruled out to conclude that a LIP has a different cause.

The Wilkes Land crater also resulted in antipodal volcanism: the Siberian Trapp basalts, likely also with two phases, see the Deccan Trapps at the Chicxulub Impact.

The word "Trappa" basalt comes from the Swedish word "Trappa" (staircase):

The Siberian "Trappa" basalts (sometimes also spelled Trap-basalts) are "staircase" basalts and are associated with the Tamyr hotspot.

Due to plate movement from the Permian to the present, traces of this hotspot can be found in northern Greenland, western Greenland, eastern Greenland, and Iceland. Lawver (2012) refers to the hotspot as the Tamyr-Iceland hotspot. The basalts in the Icelandic lava field of Odadahraun, as observed by the author, are *de facto* Trapp basalts.

Von Frese writes: "Antipodal energy also might excite volcanism at offset crustal faults, fractures, hot vents, and other preimpact structures." The Eltanin Crater, approximately 2.7 million years old, exists in Antarctica.

Its position is 57° 47′ S, 090° 47′ W. Its antipode is therefore approximately 60° N, 90° E. This is a location east of the Yenisei River in Siberia (Russia). Nothing is known about Neogene basalts there. If they exist, they may have been mistaken for the Permo-Triassic Siberian Trapp basalts. The extinction of the Pliocene Megafauna might be related to this impact. See for comparison other hypotheses as, for example, Pimiento et al. (2017).

Therefore, for known LIPs, a corresponding antipodal megaimpact should also be sought.

Some subprocesses have not yet been recognized as relevant:

These include the possibility of induced radioactivity in the resulting dust through inertial nuclear fusion. The dust from the Chicxulub impact could have been radioactive: the corresponding daughter-isotopes are then detectable in the sediments. Testing this hypothesis is a task for the future.

More relevant are the lethal effects of particulate matter in humans, as demonstrated by the World Health Organization (WHO). The amount of particulate matter was very high after the Chicxulub impact. The death rates in humans reported by the WHO are likely much higher for dinosaurs, given the much higher levels of particulate matter.

The biological relevance of particulate matter (high lethality) must be considered in the context of the Chicxulub impact. In addition to known lethal effects such as cooling and food shortages, particulate matter is another important cause of the K/T extinction event.

Similar scenarios are suspected for the Permian-Triassic extinction event and other extinction events (impact and subsequent particulate matter).

Therefore, if a meteorite with a radius of several kilometers were to strike Earth in the future, it would be recommended to remain indoors until the deadly particulate matter has been dispersed by the wind after a few days.

7 Summary and conclusion

The Cretaceous-Tertiary extinction event affected biota in many environments. The Chicxulub impactor is considered relevant to this event.

Some individual subprocesses have not yet been recognized as relevant.

These include the possibility of induced radioactivity in the resulting dust through inertial nuclear fusion. The dust from the Chicxulub impact could have been radioactive: the corresponding daughter isotopes are then detectable in the sediments. Testing this hypothesis is a task for the future.

More relevant are the lethal effects of particulate matter in humans, as demonstrated by the World Health Organization (WHO). The amount of particulate matter was very high after the Chicxulub impact. The death rates in humans reported by the WHO are likely much higher for dinosaurs, given the much higher levels of particulate matter.

The biological relevance of particulate matter (high lethality) must be considered in the context of the Chicxulub impact. In addition to known lethal effects such as cooling and food shortages, particulate matter is another important cause of the K/T extinction event.

Similar scenarios are suspected for the Permian-Triassic extinction event and subsequent extinction events (impact and subsequent particulate matter).

Therefore, if a meteorite with a radius of several kilometers were to strike Earth in the future, it would be recommended to remain indoors until the deadly particulate matter has been dispersed by the wind after a few days.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

PS: Writing – original draft.

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